International Business Research; Vol. 6, No. 1; 2013
ISSN 1913-9004 E-ISSN 1913-9012
Published by Canadian Center of Science and Education

The Optimum Discriminatory Tariffs under the Cournot-Nash Strategy in International Trade

Hui Wen Cheng[1] & Shih-Shen Chen[2]

[1] Department of International Business, Ming Chuan University, Taipei, Taiwan, R. O. C.

[2] Department of International Business and Trade, Shu-Te University, Kaohsiung, Taiwan, R. O. C.

Correspondence: Hui Wen Cheng, Department of International Business, Ming Chuan University, 250, Sec. 5, Chung Shan N. Road, Taipei, Taiwan, R. O. C. Tel: 886-2-2882-4564 ext. 2319. E-mail: hwcheng@mail.mcu.edu.tw

Received: September 27, 2012 Accepted: October 17, 2012 Online Published: December 7, 2012

doi:10.5539/ibr.v6n1p49 URL: http://dx.doi.org/10.5539/ibr.v6n1p49

Abstract

This paper investigates the optimum ad valorem tariffs under the Cournot competition. There are three situations that exceptions to most-favored-nation (MFN) principle are made within the GATT framework: free trade agreement, 'safeguard' actions and escape clause. Hence, the issue of discriminatory tariffs has important policy implications. Most of the literature concerning the discriminatory tariffs assumes that the objective of the government is to maximize their country's welfare by choosing the appropriate trade policy. We expand welfare-maximizing to loss-minimization model in order to comparing two types of optimum discriminatory tariff ratios. In the loss-minimization model, we assume that the objective of the government is to minimize loss in consumers' surplus while subject to a minimum target level of tariff revenue. The aim of this paper is to show that the optimum ad valorem tariff ratio between two exporting countries can be unambiguously derived with a linear demand curve and constant marginal costs. We conclude that the welfare-maximizing tariff ratio differs from that of the loss-minimization model or a quasi-Ramsey rule. The Ramsey-like tariff ratio does not depend on the size of the intercept of market demand since its objective function is to minimize the loss in consumers' surplus. On the contrary, the welfare-maximizing tariff ratio is dependent on the intercept since it is used to measure the total consumers' surplus. Only when the two foreign producers have the identical marginal cost will they coincide.

Keywords: discriminatory tariffs, Cournot-Nash strategy, quasi-Ramsey rule, loss-minimization model, welfare-maximizing tariff, ad valorem tariff

1. Introducation

Many of the received theory of international trade are based on the assumption of perfect competition. Applications of perfect competition to international trade are witnessed mainly in agricultural or energy products (e.g., EC feed grain trade by Peeters, 1990). Yang and Page (1993) investigate the impact of an ad valorem tax or tariff on regional productions and welfare within the spatially competitive framework. In contrast, third-degree price discrimination may be modeled in terms of various forms of taxes or tariffs (Yang, 1993). However, as Dixit (1984) indicated, it is becoming increasingly evident that a significant proportion of international business takes place in imperfectly competitive markets, especially in oligopolistic markets. Recent research is growing rapidly. They include the following works: welfare effects of export cartel and import tariffs by Brander and Spencer (1981, 1984); the impact of free entry on welfare by Venable (l985); export subsidy and productivity by de Meza (1986); optimal trade policy by Eaton and Grossman (1986); the relationship between antitrust tariff and welfare by Fung (1987), countervailing tariffs on foreign export subsidy by Dixit (1988); export subsidy and welfare by Mai and Hwang (1987); the welfare analysis under discriminatory tariffs by Hwang and Mai (1991); and Kuo and Hwang (1991).

Even though the General Agreement on Tariffs and Trade (GATT) prohibits the practice of discriminatory tariffs, there are three situations that exceptions to most-favored-nation (MFN) principle are made within the GATT framework. The first case is free trade agreement under Article XXIV. The second case is 'safeguard' actions under Article XIX, the well-known escape clause. The third case is retaliatory actions under the dispute settlement mechanism of Article XXIII (Ederington & McCalman, 2003). Hence, it has important policy implications. Most of the literature concerning the discriminatory tariffs assume that the objective of the government is to maximize their country's welfare by choosing the appropriate trade policy, that is, the importing country chooses its tariffs to maximize the sum of consumer surplus and revenue from tariffs (Hwang & Mai, 1991; Li, Means Jr., Chen & Peng, 1996; Yang, Peng & Li, 1996; Horiba & Tsutsui, 2000; Liao & Wong, 2006; Liao, 2008; Saggi, 2009; Hashimzade, Khodavaisi, & Myles, 2011a, 2011b).

Our model is based on that by Hwang and Mai (1991) in which they derived the optimum per unit tariff ratio in terms of maximum domestic social welfare. We expand their paper in two respects. First, we expand per unit tariff to the ad valorem tariff which is levied as a percentage of the constant marginal cost or the F.O.B. price of the product. The ad valorem tariff is frequently practiced in international trade. For example, the most favored nation status has most tariffs between 4 and 12 percent. Hence, our result, being different from theirs, shed new light on the topic of optimum tariffs. Second, we derive another set of optimum tariff ratios based on the assumption of minimizing loss in consumers' surplus while subject to a minimum target level of tariff revenue (Note 1). This is similar to the Ramsey rule under the perfect competition (1927). It is well known that the Ramsey rule is theoretically elegant and practically relevant since it takes tariffs revenue into consideration. The aim of this paper is to show that the optimum ad valorem tariff ratio between two exporting countries can be unambiguously derived with a linear demand curve and constant marginal costs. It is to be noted that without the assumptions on demand and cost, the result is ambiguous and uninteresting. Such optimum tariff ratios, including Ramsey-like rule, to the best of our knowledge, have not been proposed in the literature of the ad valorem tariff. In addition, from the viewpoint of the optimum trade policy, the marginal costs or the F.O.B. prices of the exporters may well be used as one of the bases on which the tariffs are levied.

2. The Welfare-maximizing Discriminatory Ad Valorem Tariffs under Cournot-Nash Strategy

Following Hwang and Mai (1991), consider a market structure in which only two foreign producers serve a domestic market with a homogeneous product. In addition, the two foreign firms, in absence of a domestic producer, practiced the Cournot-Nash strategy perhaps due to the fear of an antitrust tariff. That is, while an open collusion between two foreign producers dominates the Cournot strategy, they may well encounter stiff retaliatory tariffs. For simplicity, we employed a linear market demand curve with two constant marginal costs (Note 2). Under the Cournot competition, the demand, cost and profit functions can be show as:

$$P = a - bQ = a - b(q_1 + q_2) \tag{1}$$

$$TC_1 = F_1 + C_1 q_1 \tag{2}$$

$$TC_2 = F_2 + C_2 q_2 \tag{3}$$

$$\pi_1 = Pq_1 - TC_1 \tag{4}$$

$$\pi_2 = Pq_2 - TC_2 \tag{5}$$

where F 's are total fixed costs; C 's are constant marginal costs; π 's are profit functions; and $a > C$'s .

One form of the valorem tariff t_1 on the total production cost is equivalent to shifting the marginal cost curves up by t_1 percent (see Yang, 1989) or

$$\pi_i = Pq_i - (1+t_i)TC_i \tag{6}$$

The first-order condition of maximizing equation (6) and solving for q_i 's yields

$$q_1^* = [a - 2(1+t_1)C_1 + (1+t_2)C_2]/3b \tag{7}$$

$$q_2^* = [a - 2(1+t_2)C_2 + (1+t_1)C_1]/3b \tag{8}$$

$$Q^* = [2a - C_1 - C_2 - t_1 C_1 - t_2 C_2]/3b \tag{9}$$

hence

$$\partial q_1^*/\partial t_1 = -2C_1/3b \quad \text{and} \quad \partial q_1^*/\partial t_2 = C_2/3b \tag{10}$$

$$\partial q_2^*/\partial t_2 = -2C_2/3b \quad \text{and} \quad \partial q_1^*/\partial t_1 = C_1/3b \tag{11}$$

$$\partial Q^*/\partial t_1 = -C_1/3b \quad \text{and} \quad \partial Q^*/\partial t_2 = -C_2/3b \tag{12}$$

The standard welfare measure is the sum of the consumers' surplus (Note 3) and tariff revenue or

$$W(t_1,t_2) = \int_0^{q_1^*+q_2^*} P(u)\,du - P^*Q^* + t_1C_1q_1^* + t_2C_2q_2^* = \tfrac{1}{2}bQ^{*2} + t_1C_1q_1^* + t_2C_2q_2^* \quad (13)$$

The welfare-maximizing discriminatory tariffs can be readily derived from differentiating C with respect to t_1 and t_2 or

$$\partial W(t_1,t_2)/\partial t_1 = bQ^*(\partial Q^*/\partial t_1) + C_1q_1^* + t_1C_1(\partial q_1^*/\partial t_1) + t_2C_2(\partial q_2^*/\partial t_1) = 0 \quad (14)$$

$$\partial W(t_1,t_2)/\partial t_2 = bQ^*(\partial Q^*/\partial t_2) + t_1C_1(\partial q_1^*/\partial t_2) + C_2q_2^* + t_2C_2(\partial q_2^*/\partial t_1) = 0 \quad (15)$$

Substituting equations (10), (11), and (12) into equations (14) and (15) and rearranging, we can solve for the welfare-maximizing discriminatory tariffs:

$$t_1^* = (2a - 3C_1 + C_2)/8C_1 \quad (16)$$

$$t_2^* = (2a - 3C_2 + C_1)/8C_2 \quad (17)$$

$$t_1^* - t_2^* = (C_2 - C_1)(2a + C_1 + C_2)/8C_1C_2 \quad (18)$$

It is evident that (i) $t_1^* = t_2^*$ if $C_1 = C_2$, and $t_1^* > t_2^*$ if $C_2 > C_1$. The optimum tariff ratio t_1^*/t_2^* depends critically on a and C. In particular, the higher the marginal cost of the exporter is, the lower the tariff will be imposed based on the criterion of welfare maximization. It is of great interest to know if the welfare-maximizing tariff ratio differs from that of the loss-minimization model or a quasi-Ramsey rule. That is, the optimum tariff ratio that minimizes the loss of consumers' surplus while it maintains a minimum level of tariff revenue.

3. The Welfare-minimizing Discriminatory Ad Valorem Tariff

The optimum ad valorem tariff ratio of the previous section was derived under the criterion of maximizing the total domestic welfare. Perhaps, a more relevant objective for an importing country is to minimize the loss in consumers' surplus subject to a minimum level of target revenue. Evidently, there is a trade-off between the consumers' surplus and tariff revenue. Extracting economic rents from foreign producers will necessarily lead to a higher domestic price, hence lower consumers' surplus. The conflict between the tax revenue authority and consumers may be resolved by such a formulation. Besides a target amount of tariff revenue is often needed especially in the era characterized by financial austerity. In this light, the objective function of the Ramsey-like tariff rule can be formulated as:

$$\underset{t_1,t_2}{Minimize} \quad D = \tfrac{1}{2}(P_1 - P_0)\cdot(Q_1 + Q_0) \quad (19)$$

$$\text{subject to} \quad t_1C_1q_1 + t_2C_2q_2 = k \quad (20)$$

where $P_1 - P_0$ = difference between the optimum Cournot price with the ad valorem tariff (P_1) and without the ad valorem tariff (P_0); Q_0 and Q_1 are the optimum Cournot quantities without the tariff and with the tariff respectively; and k is a target amount of tariff revenue. The tariff would certainly decrease the consumption due to a higher domestic price. Equation (19) represents the loss of consumers' surplus. Note that the domestic welfare loss is equivalent to the loss in consumers' surplus since the profits of foreign producers have no direct bearing on domestic welfare Level. Unlike the famed welfare loss triangle in perfect competition, the loss in consumers' surplus in the Cournot model can be represented by the trapezoid of which the height is $P_1 - P_0$ and two bases are Q_0 and Q_1 respectively.

In addition, the change in the prices and qualities need not be infinitesimally small since the demand curve is linear. The welfare loss can be accurately measured by the trapezoid area via equations (9) and (1) or

$$D = [(t_1C_1 + t_2C_2)/3][(4a - 2C_1 - 2C_2 - t_1C_1 - t_2C_2)/6b] \quad (21)$$

The Lagrangian equation and its corresponding first-order conditions are

$$L = D + \lambda(k - t_1C_1q_1 - t_2C_2q_2) \quad (22)$$

$$\partial L/\partial t_1 = (4a - 2C_1 - 2C_2)C_1 - 2C_1(t_1C_1 + t_2C_2)/18b - \lambda C_1q_1 = 0 \quad (23)$$

$$\partial L/\partial t_2 = (4a - 2C_1 - 2C_2)C_2 - 2C_2(t_1C_1 + t_2C_2)/18b - \lambda C_2q_2 = 0 \quad (24)$$

Dividing equation (23) by equation (24) and assuming $\lambda \neq 0$ (Note 4), we have,

$$[(4a - 2C_1 - 2C_2) - 2(t_1C_1 + t_2C_2)]/[(4a - 2C_1 - 2C_2) - 2(t_1C_1 + t_2C_2)] = q_1/q_2 = 1 \quad (25)$$

or $q_1 = q_2$. Note that the two firms still obey the profit-maximizing assumption under the Cournot competition. Hence, from equations (7) and (8), we have the optimum tariff ratio for the profit-maximizing Cournot firms:

$$(1+t_1^{**})/(1+t_2^{**}) = C_2/C_1 \tag{26}$$

It is clear from equation (26) that the higher the marginal cost of the foreign producer is, the lower the tariff would be. To compare equation (26) with the optimum tariff ratio under the criterion of the welfare maximization, we obtain from equations (16) and (17) the following ratio:

$$(1+t_1^{*})/(1+t_2^{*}) = C_2(2a+5C_1+C_2)/C_1(2a+5C_2+C_1) \tag{27}$$

The welfare-maximizing tariff ratio is equivalent to that under the Ramsey-like rule only if $C_1 = C_2$. In that case, both criteria require an identical tariff. But in general, they differ. In the case of $C_2 > C_1$, it follows immediately that $2a+5C_1+C_2$ is less than $2a+5C_2+C_1$; hence, the optimum ratio under the maximum domestic welfare is less than that under the Ramsey-like rule. The reverse holds for $C_1 > C_2$ by the same reasoning. Note that higher ratio in terms of $1+t$'s translates into higher difference between t 's. It is important to know that the Ramsey-like tariff ratio does not depend on the size of the intercept (a) since its objective function is to minimize the loss in consumers' surplus. On the contrary, the welfare-maximizing tariff ratio is dependent on the intercept since it is used to measure the total consumers' surplus. Finally, for a given ratio of two marginal costs, the optimum Ramsey-like tariff ratios can be conveniently calculated from equation (26), i.e., $t_1^{**} = 1.2$ and $t_2^{**} = 0.1$ or $t_1^{**} = 1.4$ and $t_2^{**} = 0.2$ for $C_2/C_1 = 2$. That is, there exists a set of infinite combinations of tariffs of two importing countries that satisfy equation (26) based on the Ramsey-like rule.

4. Concluding Remarks

In this paper, we have compared two types of optimum discriminatory tariff ratios. They are found to be genuinely different. Only when the two foreign producers have the identical marginal cost will they coincide. The Ramsey-like rule is perhaps more empirically relevant in the sense that a target level of tariff revenue is required while the welfare-maximizing ad valorem tariff ratio does not take into consideration the minimum target tariff revenue.

Acknowledgements

I would like to thank professor Yang for proofreading the manuscript. All remaining errors, however, are ours.

References

Brander, J. A., & Spencer, B. J. (1981). Tariffs and the extraction of foreign monopoly rent under potential entry. *Canadian Journal of Economics, 14*(3), 371-389. http://dx.doi.org/10.2307/134894

Brander, J. A., & Spencer, B. J. (1984). Trade welfare: Tariffs and cartels. *Journal of International Economics, 16*, 227-242. http://dx.doi.org/10.1016/S0022-1996(84)80002-1

Dixit, A. (1984). International tradepolicy for oligopolistic industries. *The Economic Journal*, *94*, 1-16. http://dx.doi.org/10.2307/2232651

Dixit, A. (1988). Antidumping and countervailing duties under oligopoly. *European Economic Review*, *32*(1), 55-68. http://dx.doi.org/10.1016/0014-2921(88)90034-7

Eaton, J., & Grossman, G. M. (1986). Optimal trade and industrial policy under oligopoly. *Quarterly Journal of Economics*, *101*, 383-406. http://dx.doi.org/10.2307/1891121

Ederington, J., & McCalman, P. (2003). Discriminatory tariffs and international negotiations. *Journal of International Economics*, *61*(2), 397-424. http://dx.doi.org/10.1016/S0022-1996(03)00004-7

Fung, K. C. (1987). Industry structure, antitrust and tariffs. *International Journal of Industrial Organization*, *5*(4), 447-456. http://dx.doi.org/10.1016/S0167-7187(87)80006-1

Hashimzade, N., Khodavaisi, H., & Myles, G. D. (2011a). Uniform versus discriminatory tariffs. *Review of Development Economics*, *15*(3), 403-416. http://dx.doi.org/10.1111/j.1467-9361.2011.00616.x

Hashimzade, N., Khodavaisi, H., & Myles, G. D. (2011b). MFN status and the choice of tariff regime. *Open Economies Review*, *22*(5), 847-874. http://dx.doi.org/10.1007/s11079-010-9178-9

Horiba, Y., & Tsutsui, S. (2000). International duopoly, tariff policy and the superiority of free trade. *Japanese Economic Review, 51*(2), 207-220. http://dx.doi.org/10.1111/1468-5876.00147

Hwang, H., & Mai, C. C. (1991). Optimum discriminatory tariffs under oligopolistic competition. *Canadian Journal of Economics*, *24*(3), 693-702. http://dx.doi.org/10.2307/135589

Kuo, H. O., & Hwang, H. (1991). Discriminatory tariffs versus uniform tariffs. *Academia Economic Paper*, *19*(2), 233-244.

Li, J., Means, D. B., Chen, L. S., & Peng, H. P. (1996). A cournot competition model with the uniform pollution tariff: An application to NAFTA. *International Journal of Environment and Pollution, 6*(1), 50-56.

Liao, P. C. (2008). International R&D rivalry with spillovers and tariff policies. *Open Economies Review*, *19*(1), 55-70. http://dx.doi.org/10.1007/s11079-007-9021-0

Liao, P. C., & Wong, K. Y. (2006). Uniform versus discriminatory tariffs: When will export taxes be used? *Southern Economic Journal, 72*(4), 915-925. http://dx.doi.org/10.2307/20111860

Luenberger, D. G. (1973). *Introduction to linear and nonlinear programming.* Reading, MA: Addison-Wesley.

Mai, C. C., & Hwang, H. (1987). Domestic export subsidy and foreign welfare. *Economics Letters, 23*, 185-188. http://dx.doi.org/10.1016/0165-1765(87)90036-X

Peeters, L. (1990). A spatial equilibrium model of the EC feed grain sector. *European Review of Agricultural Economics, 17*(4), 365-386. http://dx.doi.org/10.1093/erae/17.4.365

Ramsey, F. P. (1927). A contribution to the theory of taxation. *The Economic Journal, 37*(145), 47-60. http://dx.doi.org/10.2307/2222721

Saggi, K. (2009). The MFN clause, welfare, and multilateral cooperation between countries of unequal size. *Journal of Development Economics*, *88*(1), 132-143. http://dx.doi.org/10.1016/j.jdeveco.2008.01.006

Willig, R. D. (1976). Consumers' surplus without apology. *American Economic Review*, *66*(4), 589-597.

Yang, C. W. (1989). A note on the musgravian transformation. *Eastern Economic Journal, 15*(3), 229-234.

Yang, C. W. (1993). Taxation and the output and welfare of third-degree price discrimination. *Southern Economic Journal*, *59*(3), 371-384. http://dx.doi.org/10.2307/1060277

Yang, C. W., & Page, W. P. (1993). Sensitivity analysis of tax incidence in a spatial equilibrium model. *The Annals of Regional Science*, *27*(3), 241-257. http://dx.doi.org/10.1007/BF01581661

Yang, C. W., Peng, H. P., & Li, J. F. (1996). The optimum uniform and discriminatory taxes or tariffs of third-degree price discrimination. *International Review of Economics and Finance*, *5*(1), 77-84. http://dx.doi.org/10.1016/S1059-0560(96)90007-6

Notes

Note 1. The difference between third-degree price discrimination and our model is that there exists two independent demand markets and one producer in the former case; but one demand market with two suppliers in the latter case, see Yang (1993).

Note 2. For a nonlinear demand and nonconstant marginal costs, one can apply the same procedure, but no easy and convenient result can be obtained, see Hwang and Mai (1991).

Note 3. We assume an insignificant income effect so that the ordinary demand curve is a good approximation for the compensated demand curve, see Willig (1976) for justification.

Note 4. This is a trivial case in which the Lagrangian multiplier is zero with an equality constraint. For details, see Luenberger (1973).